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The author discusses the testing of the validity of self-pacing in a two-year programed German course at Colorado State University. Two teaching situations were set up for the programed materials. The first group, 24 students who met in a room "equipped somewhat like a language laboratory," were "self-paced," using books, tapes, and a tape recorder. They were encouraged to ask questions, which were answered individually. For the second group, 34 students in a regular classroom, the same programed materials were put on transparencies and used with an overhead projector, a loudspeaker, and a screen. This group also encouraged to interrupt at any point with questions, which were answered briefly (and usually in English). The students responded in unison when an oral response was required, and kept notebooks for written responses. The teacher, standing so that he could see when the students were finished writing, paced the presentation of the frames accordingly. Various tests were given to these two groups, along with a third group of several conventional classes. Because of inadequate controls, the author feels that the results are inconclusive. However, "it is easy to conclude," he reports, "that even though the achievement tests did not measure the skills that were given the most emphasis in the program, these (programed) students more than held their own with students receiving the conventional type instruction." (AMM)

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THE CONCEPT OF THE DIRECTED PROGRAM

In the summer of 1960 I was invited to join the staff of the Encyclopedia Britannica Films, which at that time was doing pioneering work on programmed materials. Previous to this, experimentation on programmed mathematics was showing positive results, and it was felt that the principles which were being evolved for programmed mathematics could be adapted to foreign language teaching. My particular task was to see how these principles could be applied to instruction in the German language. Fortunately the techniques my wife and I had developed for the teaching of German to grade-school children were somewhat similar to programming, although at the time we were quite unaware of this fact. At any rate the transition from the problems of teaching German to third grade children to the problems of programming the language for older learners was not an impossible leap. Even so, the task was an arduous one, and we wrote, tested, and rewrote several times before the basic principles of teaching a foreign language by this means emerged. After two years we had accomplished the task and had completed our contract with Britannica.

From the beginning there was one principle of programming that bothered us no end: the principle of self-pacing. Some programmers took the attitude that the teacher was becoming obsolete and would be replaced by a machine in the future classroom. But nobody really tested and experimented with this principle. It was just taken for granted that the best way for every student to learn was as his own individual pace. As a consequence all programs then being written were geared to this approach, including our own German program. No one seemed to be inclined to ask whether some students perhaps profited from being in competition with their fellow learners, or perhaps needed the support of another human being.

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With the termination of my contract with E.B.F. I returned to teaching, determined to test the validity of self-pacing in a programmed German course. Although most of the experimental subjects who had been used in the testing had done remarkably well, one could not deny the fact that they were paid to take the course, were generally very superior students, and individuals with a good deal of inner motivation. Previous years of teaching had warned me that even among college students this type of individual was not the rule, but the exception, and it was too much to assume that equal results would be obtained by an ordinary class of college freshmen subjected to all the distractions and foibles that are usually found in such a group. In order to explore some of these ideas, in the fall of 1962, at Colorado State University, I set up two teaching situations, using our programmed materials. In one class I simply issued books and tapes and asked the students to proceed to learn German with the help of a tape recorder. For the other class, we had the program put on transparencies and with the help of an overhead projector, a loud speaker for the recorder, and a screen, I taught and directed the pace of the progress of the students. Experience with self-pacing had already indicated that problems in the area of language learning should be resolved immediately, so I encouraged the students in this teacher-directed class to interrupt whenever any point of structure troubled them, or even to ask for a word or a phrase that might have escaped them in this kind of language give and take. I found that 99% of these questions could be answered adequately in just a few seconds, and I openly used English as the basis of explanation. I stringently avoided any long discourse on the intricacies of grammar because this merely tended to confuse the students more than no answer at all. I soon discovered also that the type of questions asked put me on my toes, for the questions were asked out of a knowledge of German, not from an ignorance of German, so that I had to answer in a few secons questions

which were sharp and demanded a comprehensive view of the entire course. At the same time I could not ramble off on a tangent, as the students were eager to get the matter settled and get back to the program. Once I realized this, I carefully prepared each day's work, trying to anticipate questions. In this I was successful and the class moved at a fast pace, its speed being only partly determined by me, and mostly by the students themselves. They were learning; they knew it, and they wanted the new structures to come fast.

The students in the self-paced class were also urged to ask questions whenever they needed help, but since each student was at a different place in the program, questions had to be answered individually. Here we did not experience any 'swing' to the entire class, as each individual competed only with himself, and often the competition was very poor! Before the year was over, the Psychology Department at the University became interested in this project and decided to help me conduct a more meaningful experiment by giving a variety of aptitude and attitude tests. The first year, however, was important in that the experimentation, inconclusive though it was, did at least reduce some of the troublesome areas, and it was unquestionably true that the tests for the teacher-directed class indicated that these students were learning more deeply and intensively, as well as more enthusiastically.

In the second year, as in the first, we did not make any attempt to select students according to intelligence or any other factor. We felt we were justified in this because all students choosing any language course at a University gather as a random group, we wanted to feel that the programmed instruction was being subjected to the same conditions as conventional classes, and the number of students selected German, or any other class, represent in any event only a small percentage of the student population, a factor which in itself somewhat mitigates the validity of such an experiment. We frankly were not seeking conclusive results at this point; we were merely seeking trends upon which a more meaningful experiment could be based later.

One group of twenty-four students met in a room equipped somewhat like a language laboratory. Each student was supplied with a tape recorder and a complete program which included books and tapes. They were required to bring only a notebook and pen to class. Then the students were told to proceed at their own pace, seeking help from the teacher when they felt the need. They were informed, however, that they were expected to complete the program by the end of the academic year. This, of course, somewhat modified the concept of self-pacing, but it was necessary to impose this limitation on them for their own protection, because if any student dawdled to the extent that he did not finish the first-year programmed German course, he would be at a serious disadvantage in the second year, and he could hardly have received full credit for the first-year course. The other class started with thirty-four members, meeting in an ordinary classroom. Using the transparencies with the overhead, the program was projected, one frame at a time, onto a screen, and a single tape recorder set on loud speaker was operated by the teacher. The class responded in unison when an oral response was required. For written responses each student kept a notebook. The teacher stood so that he could see when students were finished writing and paced the presentation of the next frame accordingly. He could also detect gross errors in pronunciation and drill the class in the correct response without causing embarrassment to any individual. Both classes were scheduled to meet five times a week for an hour at a time. Examinations were administered at the end of every thousand frames. The students in the self-paced class informed the teacher when they reached these points and the tests were given individually. The teacher-directed class took them as a class, just as any conventional class would do. The teacher was always present during the hour that the self-paced class was scheduled to meet so that students were free to ask questions if they needed help. The room was also open at some extra hours, so that those students who worked more slowly could come in and continue with the program.

It was well that we allowed ourselves one full year to become acquainted with some of the difficulties in a programed class, both self-paced and teacher-directed. We fouid that we had not allowed sufficient time in the teacher-paced class to finish the program, so the second year we scheduled the two programmed classes for two hours a day, ten hours a week, although the same credit (5 hours) was given as was given for any of the university's beginning language classes. This extra allotment of class time was justified on the basis that students in the programmed classes had no homework assignments, while students in conventional classes were expected to spend from one to two hours a day in preparation for each class session. Although we wondered whether this two-hour scheduling would deter students from registering for the course, our fears were unfounded. As in the first year, we againhhad twenty-four self-pacers, that being the number of available tape recorders and programs, and there were thirty-five in the teacher-paced classs The two hours were not consecutive. The first hour for each class met in the morning, and the second hour for each was scheduled in the late afternoon. A student assistant was hired to oversee the self-pacers and to operate the overhead projector and tape recorder for the teacher-paced group during the second daily session, thus relieving the teacher of an undue load. All questions that the students had were deferred by the student assistant and answered by the regular teacher on the following day, a rather unsatisfactory arrangement perhaps, but the best we could devise.

In the teacher-paced group, the entire class completed the program early in May and spent the last few weeks of the spring quarter reading and carrying on discussions in German. At this time also this class was reduced to one hour a day instead of the originally scheduled two-hours. Of the twenty-four

self-pacers that started in the fall, only twelve completed the year's work, with an average score of 3.1 in the final exam, while the average of the teacher-paced group was 3.2. One must bear in mind that that average for the latter group includes weak students as well as good, for all completed the course and took the final, while the self-paced average does not include the poorer students, none of whom completed the course and took the final.

In order to have some more objective measurements of how the students were reacting to this method of instruction and how much they were learning, the Psychology Department of Colorado State University cooperated with me during this second year by administering a number of tests. We were not content merely to test programmed materials against conventional materials, but we wished above all to determine whether programmed instruction would have any validity without the element of self-pacing. Tests were, therefore, administered to three groups: the class taking the German program under a self-paced situation, the class taking the program with the teacher helping to determine the pace, and several classes taking German in a conventional situation, using a textbook and having homework assigned to be done either at home or in the language department's laboratory. First of all, the students in every one of these classes were given the Carroll-Sapon language aptitude test. In these tests the probability is that those who score high have a better possibility of doing well provided the instruction is of high quality, this latter being one of the uncontrolled variables in the experiment. At various times during the year, attitude tests were administered to all students in the different classes. These tests were created by Dr. Charles Neidt, head of the psychology department, and a pioneer in the field of attitude measurement. These tests were designed to see how the students were reacting to the method used, whether they were satisfied with the approach

and finally whether their initial attitude was maintained as the year progressed and the novelty wore off. Finally, at the end of the year, all these beginning German students were given the ETS (Educational Testing Service) standardized German examination (written form only). This test is designed to measure the student's mastery of various elements in the language. Although the students in the programmed classes did not show the highest aptitude for language learning according to the Carrooll-Sapon test, these students consistently scored highest on the attitude scales, and came out on top in the ETS achievement test. Of the two programed classes, the teacher-directed group had the lower aptitude score, but the higher attitude and achievement scores.

The accompanying graphs illustrate the results of the tests given. The aptitude and achievement tests are nationally known. The attitude tests, as I have indicated, were developed at Colorado State University under the direction of Dr. Neidt. As one can see, the number of students tests was small, and that fact detracts from the validity of the entire venture. Yet, in spite of this, there are some interesting trends here, which should be discussed.

First, let me say a few words regarding the evaluation of these graphs. The standardized German test given has been dsigned expressly for students being prepared in a conventional language course, and only the written forms were used. In this, heavy emphasis is placed on the acquisition of vocabulary, a knowledge of rules of grammar and memorization of idiomatic constructions. In the programmed course, on the other hand, the emphasis is on listening comprehension and automatic responses in acceptable German to aural stimuli. Grammar rules as such may be 'discovered' by the student after he has become familiar with a structure through usage. Once the student

has formulated his own rules, they are used as reminders, to help inhibit errors in the future. Vocabulary is necessarily very limited as the emphasis is upon gaining control of structure rather than sterile memorization of isolated words or idioms. Thus the really strong ponts of the program were not tested in the ETS examination used, so that the students in the conventional classes had an advantage over those in the programmed classes.

One must also keep in mind the relationship of the aptitude scores with the achievement scores. Conventional teacher two, with a class of only eight students whose average aptitude was 70.75 had the second highest achievement score of 50.38, which is .21 above the self-paced programed class, whose average aptitude was 66.17, more than four points below that of this small conventional class. Notice, too, that the aptitude of the teacher-paced class was only 59.36, and one of the conventional classes had an aptitude score of 58.26, a difference of about one point. Yet on the achievement of these two comparable groups, the [illegible] teacher-diredted programmed class [illegible] surpassed the conventional group by nearly fifteen points. The reader must be reminded that the number completing the various German courses, programmed and conventional, is very small, so that validity of the scores can be questioned. One may well ask, however, what the score of the class would have been if the teacher-paced group had had as high an aptitude score as the highest scoring conventional class (70.75). Notice that the average achievement for all classes of 44.00, and both programmed groups scored well above this. Likewise, the average aptitude score is 62.50, above the score of the teacher-paced class, although below that of the self-paced class. It is easy to conclude from these figures that even though the achivement tests did not measure the skills that were given the most emphasis in the program, these students more than held their own with students redeiving the

conventional type instruction which the tests were designed to measure. It is impossible to say how much the achievement scores were affected by the better attitude of the students in the programmed class. Undoubtedly, attitude plays a large part in learning. And as I indicated earlier, it is not possible to say what part was played by the personalities of the various teachers involved.

These charts are making a comparison between different methods being employed by teachers to train students in the use of the German language. Besides this, they make a comparison between a program being used in a self-paced and a teacher-paced situation. Our experiment here would indicate that the element of self-pacing may have been over-emphasized. Perhaps the grouping of students according to speed of learning is adequate, so that a program would be paced to meet the needs of each group. It is highly possible that students stimulate each other in the learning situation, especially under the conditions of the program where all of them were involved with the stimulus-response procedure all of the time. The final answer, after all, may very well lie in a combination of the best features of conventional teaching with the best features of programmed instruction.

We do not claim for a moment that the material presented in this paper, or even in the graphs, is final and conclusive. Lest someone should be inclined to so interpret it, let me point out here some of the various and obvious weaknesses of the experiment.

1. We had no adequate controls. At the time we did not feel this was serious, as we were more interested in trying out some ideas than in reaching conclusions. We do believe, however, that our experimentation may stimulate some research in this area which will produce conclusive results.

2. Only one teacher was involved in the programmed part of the experiment, and, to make matters worse, that teacher was the author of the program and he naturally exuded all kinds of enthusiasm, which undoubtedly affected the attitudes and perhaps even the achievement of his students.

3. A serious weakness arose from the fact that neither the administration nor the language department at Colorado State University was willing to lend its support and backing to this experiment. The language teachers at the institution knew nothing about programming and cared less, and this attitude was shared by the administration to some extent. This, too, may have affected the students in the conventional classes.

4. A student assistant was used to teach the afternoon hours of the programmed course. This fact, we feel, detracted from the validity of the experiment, for while she was herself a competent student and had completed the program during the first year it was offered, she was not able to answer questions adequately. We should have had a regularly employed German teacher.

With these weaknesses, as well as the results of the experiment, in mind, we would like to suggest some further areas of research.

1. If we seriously consider the attitude of the student having an effect upon his ability to assimilate learning, then we must also consider other factors leading to the same results. We must evaluate the effect of gregariousness, self-confidence, shyness, and persistence upon the ability to learn. How do these personality traits affect attitude and achievement?

2. In this respect also the character of the teacher may be decisive. An imaginative, patient teacher who approaches his subject and his students with enthusiasm for the subject and with a sense of humor and an understanding

of human nature can be a measurable factor in the education of the learner. Can a program take cognizance of such factors on the part of the student and teacher? If it can, then this also must be a researchable item.

3. What exactly is the role of the teacher in a programmed course, or, for that matter, in a computer-assisted program? Our experiment seems to indicate that programmed instruction puts a greater demand upon the teacher than any conventional system can. Perhaps that is why some teachers have shied away from using programs! A good program stimulates the learner to think more deeply about the subject being learned, and the learner will ask questions that will demand far greater knowledge on the part of the teacher. The teacher will have to have a comprehensive view of the entire course in order to meet the demands of future students.

4. A completely self-paced program demands a great deal from the average learner in the way of motivation and self-discipline. The idea that the learner will find sufficient motivation just because he usually comes up with the right answer has not been valid with the average freshman of my acquaintance. For the well-disciplined, mature, and highly motivated student, a good program is something he devours happily. But this student is in a small minority. What about the great majority? It stands to reason that something must be prepared that will meet the needs of the total school population. This, we believe, can be done by creating programmed courses that will keep the teacher actively engaged in the instruction. A program can and should be written for any subject in such a way that parts of the course can be used for group instruction, with frames projected so that the entire class can focus on one matter at a given moment. This approach is flexible enough so that the teacher can repeat frames when he finds it necessary, or expand and clarify when he senses that a particular class needs such help.

The teacher should also be able to stop the program at any point in order to drill his students. Even better than that, or perhaps connected with it, would be to have one or more drill sessions a week for this purpose. This is now the approach being used at a number of colleges, notably at Oakland Community College, with great success. This sort of drill is especially indicated in subjects such as foreign languages and mathematics. Such drill constitutes overlearning and is essential if real mastery of the subject is to be gained. A program can furnish information, bit it takes the teacher to make the subject come alive for the student.

In conclusion, let us simply state that while it is undoubtedly true that some teachers think they can go on teaching the same old thing in the same old way, the enrollment at our summer schools and institutes testifies to the fact that many thousands of teachers are desparately trying to keep up with new technology and new methods. It is not these teachers who are obsolete, but rather the tools they sometimes are forced to work with which are out-of-date. It is up to the creators of texts and programs to see that our conscientious teachers have the materials to use so that they can impart knowledge and skills to their pupils in the most effective manner. Only the individual, whether student, teacher, writer, administrator, or publisher, who fails to take advantage of the opportunity to try new ideas, new materials, and new techniques, can be termed obsolete. Not even the programmer, whose program is hot off the press, can claim to have found the final way to impart knowledge.

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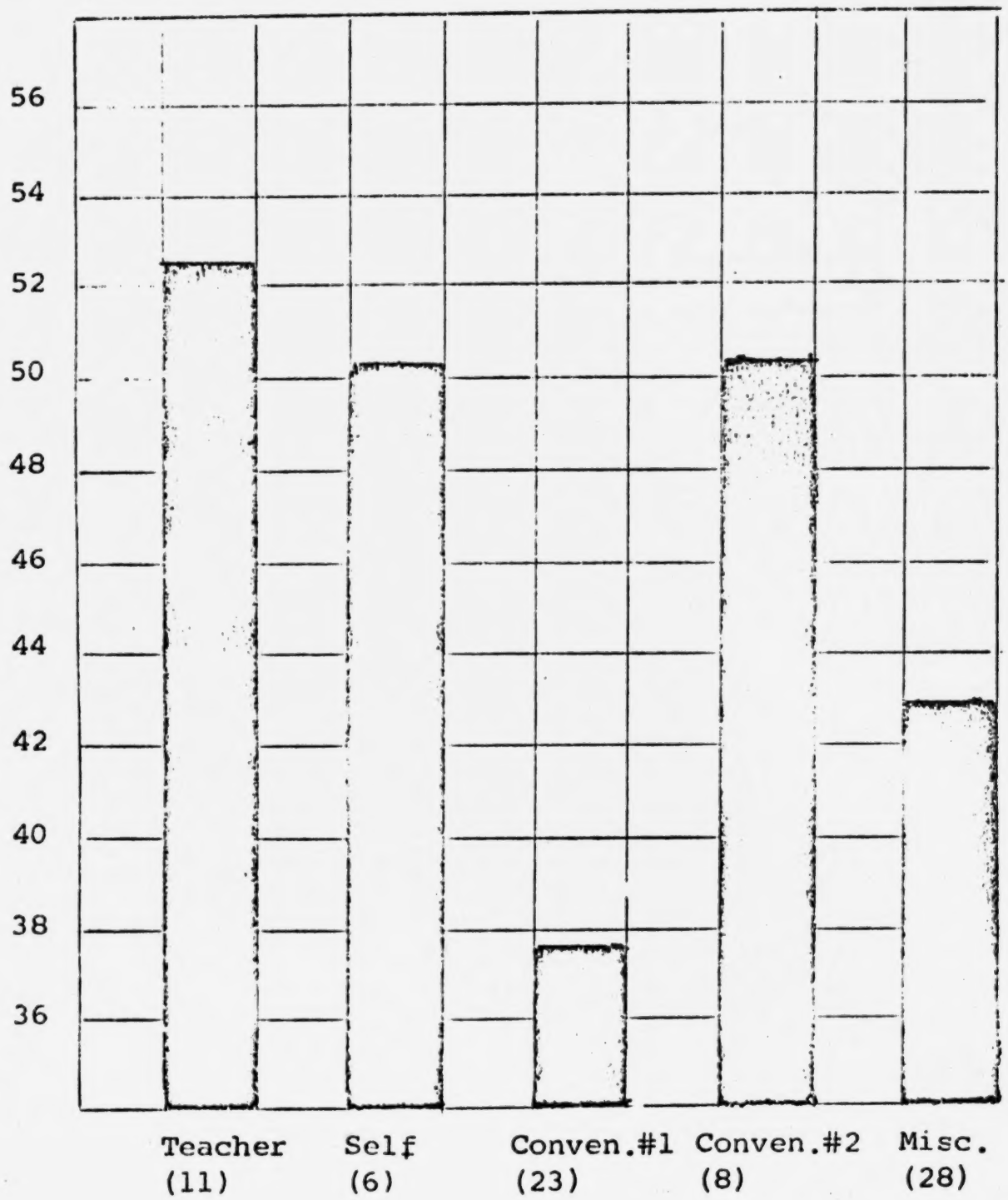
Appendix A: Results of Teacher-paced Programed Instruction in German, 1963-64.

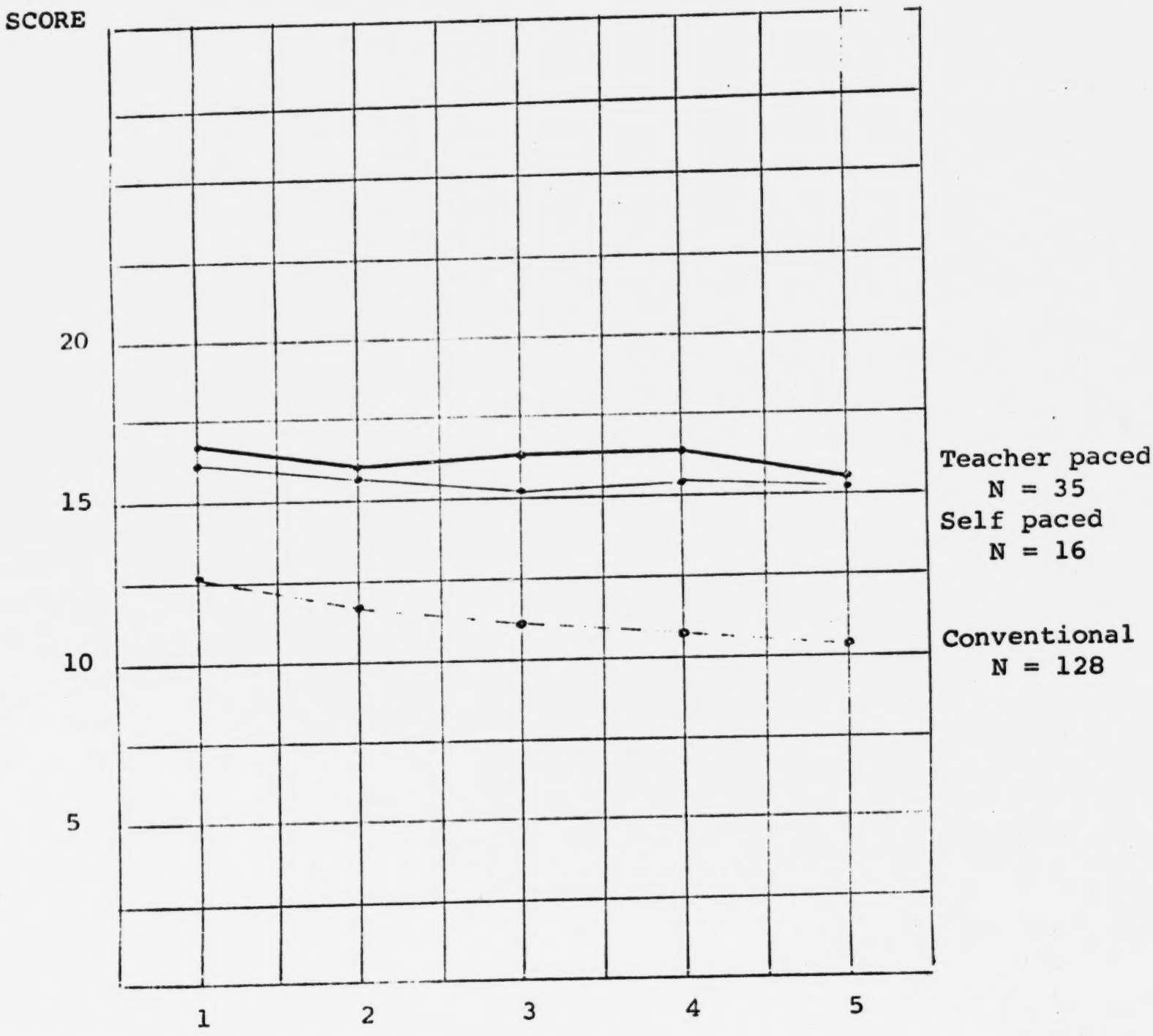
Mean Achievement Scores at End of First Year German



(Data in preceding table plotted graphically.)

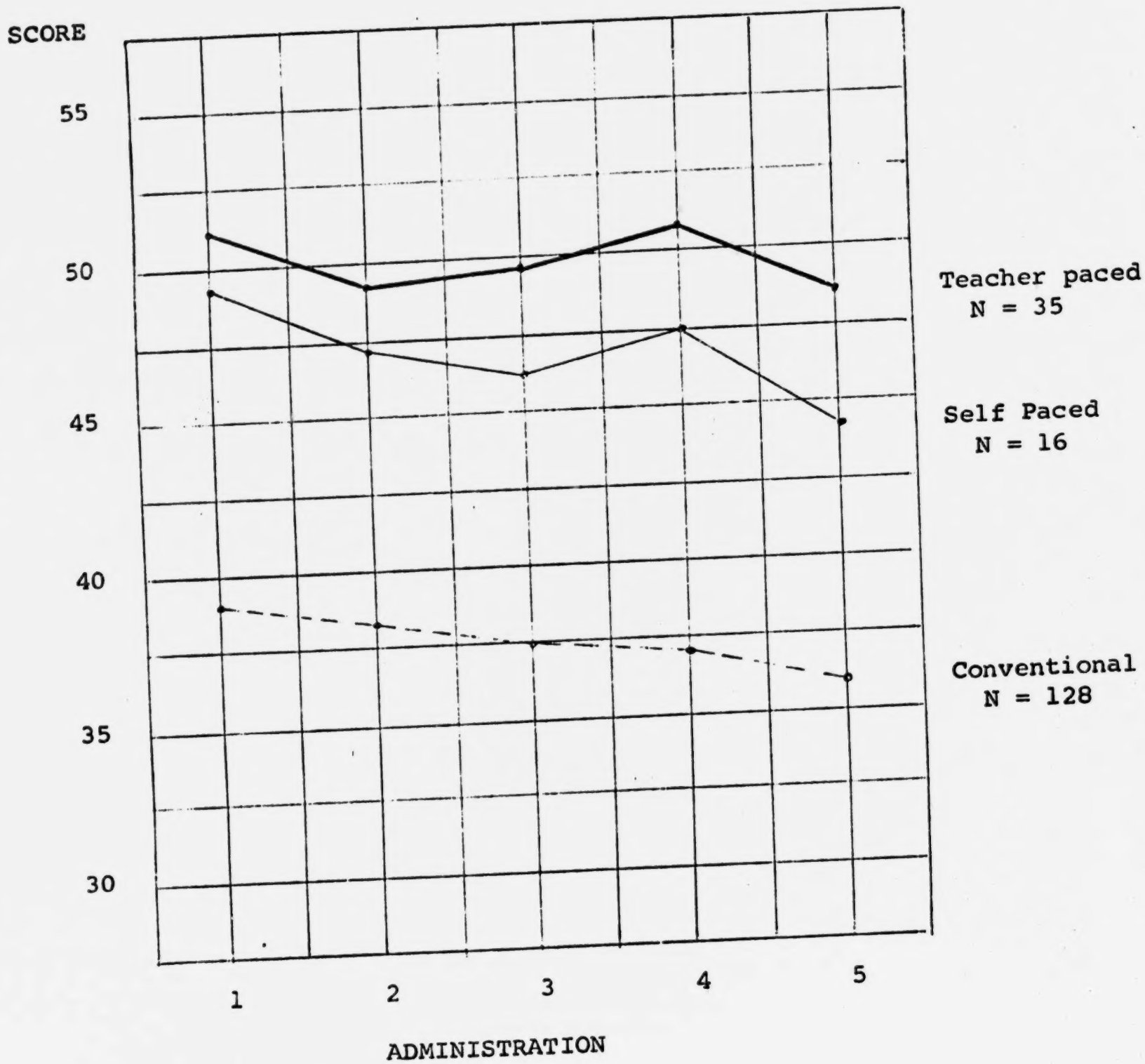
PROJECTS 1, 2 and 19

Mean Expectation Attitude Change



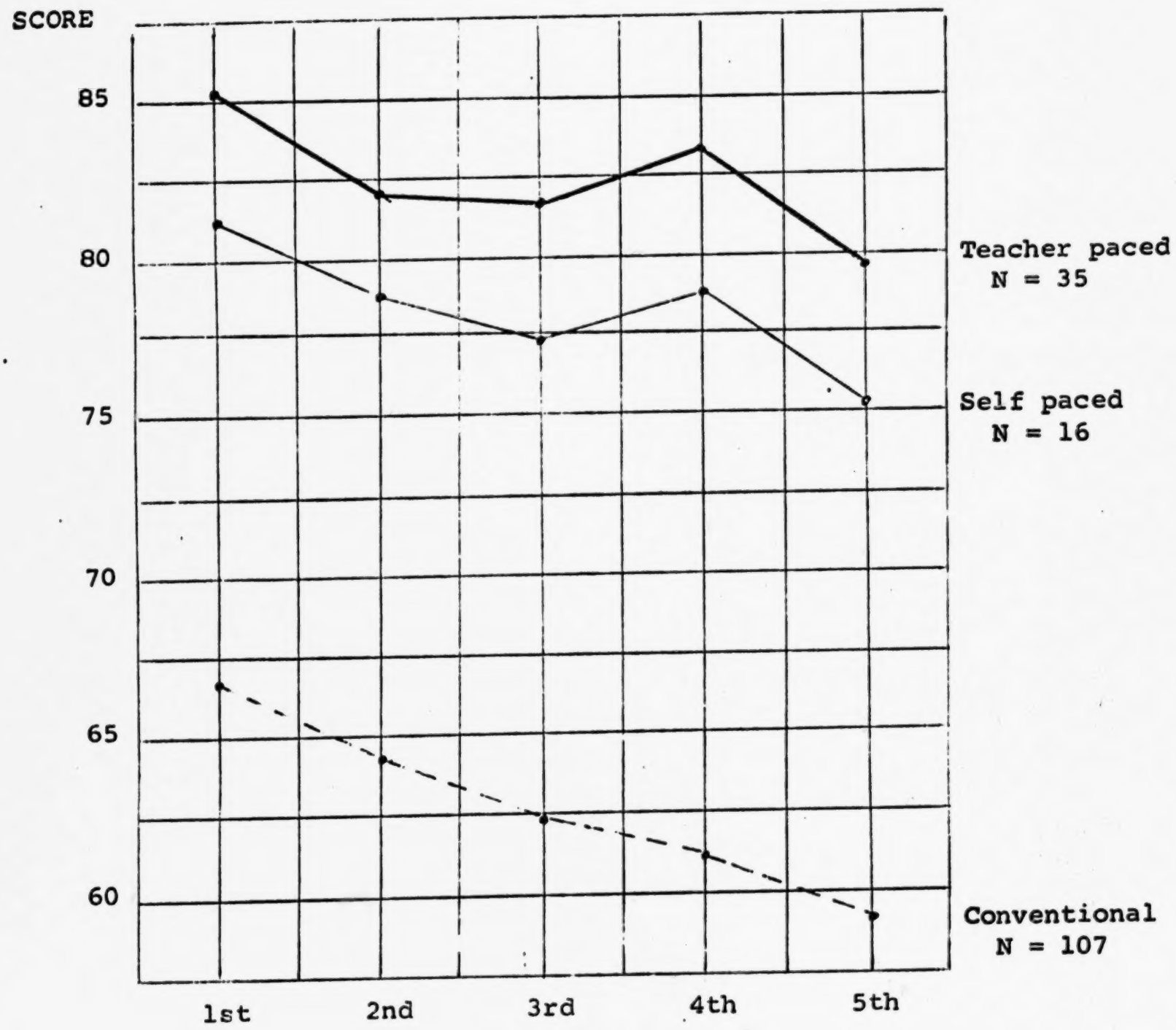
PROJECTS 1, 2 and 19

Mean Method Attitude Change



PROJECTS 1, 2 and 19

Mean Total Attitude Change



Attitude scores for students enrolled in three instructional groups in Beginning German. First Quarter, 1963-64.

(The higher the score the more favorable the attitude.)

Final Achievement Scores
for Five Groups of Beginning German Students

Group	Number	ETS German Examination Score	Foreign Language Aptitude Test Score
Teacher Paced Program	11	52.27	59.36
Self Paced Program	6	50.17	66.17
Conventional Teacher #1	23	37.52	58.26
Conventional Teacher #2	8	50.38	70.75
Miscellaneous Several Teachers	28	42.93	64.07
TOTAL	76	44.00	62.50

(The higher the score the better the performance.)